NebGuide

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Calculating the Value of Manure for Crop Production

Javed Iqbal, Extension Soil Specialist, Nutrient Management
Leslie Johnson, Extension Educator, Animal Manure Management
Amy Schmidt, Livestock Bioenvironmental Engineer

This NebGuide provides criteria and guidelines to determine the market value of manure for crop production.

Manure has value for crop production when it provides nutrients or soil amendments needed for optimum crop yields. Manure does not supply nutrients in balance with crop needs, but has the advantage of slowly releasing nutrients which reduces the risk of nitrate leaching. Manure nutrient content varies widely due to weather conditions, the livestock facility, manure storage systems, the age of manure, and feed composition. Low nutrient concentration due to weathering and dilution with water or soil decreases the value of manure. The organic material in manure also can improve soil productivity by increasing the water infiltration rate and water-holding capacity. On some soils, this gain in productivity may be more than its nutrient value.

The worksheet[1] on page 3 is used for calculating the fertilizer value of a manure source for a specific field. It includes the value of needed nutrients for a four-year period and offers the option of including the value of manure nutrients used after that. The value of other benefits of using manure, such as an expected yield increase, can be estimated. An example worksheet is included on page 4. To complete the worksheet you will need one or more recent analyses of the manure to be valued, a recent soil test for the application area, recommendations for nutrients needed for the next and following crops, and current fertilizer prices.

Determining Nutrient Value of Manure

Manure or compost should be applied at or below the rate that meets the nitrogen (N) need of the next or current crop. Applying manure to meet the crop's nitrogen needs usually results in applying substantially more phosphate (P2O5), potash (K2O), sulfur (S), and zinc (Zn) than is needed by the crop. University of Nebraska–Lincoln recommendations for P2O5, K2O, and Zn are based on meeting crop needs while slowly building soil nutrient levels.[2] This is generally the most profitable option for nutrient management. For corn, sorghum, soybean, and sugar beet, research results show no economic benefit to nutrient applications that raise soil test levels higher than 20 ppm phosphorus (P) (Bray-1 P test), 125 ppm potassium (K), and 0.8 ppm zinc. Yields of alfalfa, wheat, and six other crops respond to higher soil phosphorus levels.[3]

Applying large quantities of nutrients at one time, in excess of recommendations, may be profitable when interest rates are low and nutrients are inexpensive, as may be the case with manure nutrients. A producer receives value from these excess nutrients only if subsequent crops remove the nutrients before more nutrients are applied. This approach is acceptable for relatively immobile soil nutrients like phosphorus, potassium, and zinc, applied where or in a way such that phosphorus is not likely to be transported to surface water, and if total available nitrogen does not exceed crop utilization in year one. Nitrogen released in subsequent years from the organic-N in manure can be credited toward future crop needs.

The organic matter in manure may improve soil productivity and crop yields. For example, manure demonstration plots in Nebraska from 1996 to 2001 produced an average of 7 bu/ac more corn (14 site years) and 2 bu/ac more soybean (6 site years) where manure or manure plus fertilizer was applied compared to fertilizer alone. Soybean in one other site year lost 4.5 bu/ac due to compaction during manure application and incorporation. Line 12 in the worksheet provides a place to include the value of a yield increase. This value is typically between $0 and $60 per acre. Expect less yield increase on fine and high organic matter soil, or if the land has a recent history of manure. Expect greater increase on sandy, eroded, or disturbed soil with no recent manure history.

Manure Testing

Manure varies greatly in nutrient content so recent samples of the manure or effluent to be applied should be analyzed by a laboratory to determine nutrient content.[4] Without a lab test, a "book" value of typical nutrients in manure could be used, but this is not recommended since the actual concentration of one or more nutrients in any manure is often several times more or less than the "book" value.

Availability of Manure Nitrogen

Manure nitrogen is mostly in two forms: ammonium nitrogen and organic nitrogen. All ammonium nitrogen is available the first year if it is not lost. Ammonium nitrogen is quickly lost from manure spread in a thin layer and left on the surface of either a feedlot or a field. Cooler temperatures at time of spreading will slow ammonia loss. Ammonium nitrogen is retained once it is incorporated into the soil (Table I) by injection, tillage, or by rainfall or irrigation of one-half inch or more.

Organic nitrogen is slowly released during warm weather by microbial action. From 40 to 45 percent of the organic nitrogen in manure becomes available to crops in the first year (Table II). About 20 percent of the original organic nitrogen in manure or compost is released in year two, 10 percent in year three, and 5 percent in year four. Much of the organic nitrogen in manure is not recovered by crops in the following years.

Table I. Fraction of ammonium nitrogen available this year.

Sidedress Application			
Injected		*0.95*	
Sprinkler Irrigated		*>0.4" applied 0.8*	
		≤ 0.4" applied 0.4	
Preplant Application and Not Incorporated			
Surface applied in spring or fall		*0.00*	
Preplant Application and Incorporated			
		Temperature at Time of Spreading	
Manure Form	*Solid*	*Liquid > 50°F*	*Liquid ≤ 50°F*
Immediately	0.95	0.95	0.95
One day later	0.50	0.70	0.70
Two days later	0.25	0.45	0.55
Three days later	0.15	0.25	0.45
Seven+ days later	0.00	0.00	0.40

Table II. Fraction of organic nitrogen available this year.

Beef/Dairy Manure	
Solid or stored liquid	0.40
Composted feedlot	0.15
Swine Manure	0.40
Poultry Manure	
Layers with no bedding	0.45
All other poultry	0.40

Worksheet Instructions

Line 1: Enter the results of the manure analysis or typical values for this manure.

Line 2: Enter the ammonium nitrogen and organic nitrogen availability factors from *Table I* and *Table II*. For fall and early spring-seeded small grains, multiply the organic nitrogen factor by 0.7. For the other nutrients, because most is available the first year and the rest is available the second year, use 1.0 as an availability factor.

Line 3: After calculating available ammonium nitrogen and organic nitrogen, add the two values *(Line 3)* to get total nitrogen available per unit of manure in the first year.

Line 4: Enter the nutrient recommendations for the next crop. You may enter the average nutrient need for the crop rotation except for nitrogen, which should be that needed or used in year one. If soybean is the next crop, enter 80 lbs of nitrogen. For leguminous hay crops, enter 100 lbs of nitrogen. Sulfur is needed only on sandy soils with less than 1 percent organic matter, low soil test sulfur, and little sulfur in the irrigation water. Soybean is tolerant to low sulfur conditions.

Line 5: The planned manure application rate should be for a similar moisture content to that of the analysis.

Line 6: Total available nitrogen in *line 6* should not exceed Total nitrogen on *line 4* by more than 20 percent.

Line 7: This is the nutrient need for four years, based on recommendations in *line 4*. For lower rates of manure applied more frequently, multiply nutrients in *line 4* by the number of years between applications.

Line 8: For each nutrient other than nitrogen, compare the amounts in *lines 6* and *7*, and circle the smaller of the two amounts. For each nutrient amount circled in *line 7*, consider giving value to additional amounts as suggested in A through E below.

> **A**: Future nitrogen release of value: multiply organic nitrogen in *line 1* x *line 5* x . In the blank, use 0.1 if manure is applied before a nitrogen- requiring crop, such as corn or sorghum, in rotation with soybean. Use 0.3 where it is applied before soybean, or continuous corn or grass. Enter zero if the application will be followed by two or more years of forage legume.
>
> **B**: If soil phosphorus is less than 15 ppm Bray-1 or 10 ppm Olsen, up to 250 lbs/ac of additional phosphate can be of value. If soil P is less than 25 ppm Bray-1 or 18 ppm Olsen, up to 150 lbs of additional phosphate can be of value.
>
> **C**: If soil potassium is less than 150 ppm, up to 200 lbs/ac additional potash can be of value.
>
> **D**: If the soil is sandy and sulfur is less than 10 ppm, up to 40 lbs/ac additional sulfur can be of value.
>
> **E**: If soil zinc is less than 1.0 ppm, up to 20 lbs/ac additional zinc can be of value.

Line 9: Add the circled amount in *line 6* or *line 7* to the addi tional amounts in *line 8*, if any, and enter here. **These amounts cannot exceed those on *line 6***. For nitrogen, if manure is applied before a nitrogen-requiring crop, add *lines 6 + 8*. If not, use only *line 8*.

(*Worksheet instructions continued below worksheet*)

Worksheet to calculate the value of manure.

(Instructions for most lines are on page 2.)

For an interactive version of this worksheet visit http://go.unl.edu/manurevalue. When you input your numbers, the calculations will automatically be figured.

Manure Source: ____________________ **Field:** ____________________________ **Date:** ____________________________		Nitrogen						
		Ammonium N	Organic N	Total N	P2O5	K2O	Sulfur	Zinc
Nutrient Plan	1. Manure nutrient content from manure test report (lbs/ton, lbs/1,000 gal, or lbs/acre-inch).							
	2. Nutrient availability factors. *See Tables I and II for nitrogen availability*.				1.0	1.0	1.0	1.0
	3. Available nutrients (lbs/ton, lbs/1,000 gal, or lbs/acre-inch). Multiply *line 1* x *line 2.*							
	4. Nutrient recommendations for the next crop (lbs/acre/year).							
	5. Manure application rate. To meet crop nitrogen need, divide total nitrogen in *line 4* by *line 3* (round to whole units) (tons/ac, 1000 gal/ac,or acre-inches).							
Nutrients of Value	6. Total nutrients available (lbs/ac). Multiply each value in *line 3* x *line 5* (application rate).							
	7. Nutrient need for four years (except N) (lbs/ac). *Multiply line number 4 x 4.*							
	8. Additional nutrients of value (lbs/ac).			A	B	C	D	E
	9. Total nutrients of value (lbs/ac).							
Total and Net Value	10. Fertilizer nutrient costs ($/lb).							
	11. Manure nutrient values ($/ac). Multiply *line 9* x *line 10.*							
	12. Estimated value of yield increase ($/ac).							
	13. **Total value of applied manure** ($/ac). Sum all values in *line 11* and *line 12.*							
	14. **Manure value per unit** ($/ton, $/1,000 gal, $/acre-inch, $/load). Divide *line 13* by *line 5*, or by loads per acre.							
	15. **Manure costs:** hauling, spreading, incorporation ($/ac).							
	16. **Net value of manure** ($/ac). *Line 13* minus *line 15.*							
Need	17. Nutrients still needed for *this* year's crop (lbs/ac). *Line 4* minus *line 6.*							

Line 12: The value of increased yields from manure typically ranges from $0 to $30 per acre. The table below can be used to calculate a value. The example yield increase is based on 70 percent of the average yields described on *page 1* over a period of two years.

	Year #1				Year #2				
Value of Yield Increase	Crop	Yield Increase	Value/ unit	Value/ acre	Crop	Yield Increase	Value/ unit	Value/ acre	Total Value
Example	corn	5 bu/ac	$5.50/bu	$27.50	soybean	1.5 bu/ac	$13.00/bu	$19.50/ac	$47.00/ac

Line 15: The costs of manure-handling equipment, and the loading and spreading of manure, should be charged against the livestock operation. Only the cost of hauling it from the feedlot to the entrance of the application site, and an optional incorporation to retain the ammonium nitrogen, should be charged against manure value. The worksheet example on the last page shows one example of this.

Line 17: If the difference is negative, enter zero. For this, *line 4* must NOT be a multi-year average of recommendations.

Example: Cattle manure from a dirt lot is applied on a sloping silt loam soil, and is incorporated one day later. It is applied before corn, in rotation with soybean, with no history of manure, at a rate that meets the nitrogen requirements for corn with an expected yield of 130 bu/ac. Soil test results are: 3 ppm soil nitrate (0-36 inches), 2 percent O.M., Bray-1 P = 12 ppm (low); K = 205 ppm (very high); Zinc = 0.7 ppm (medium).

Sample worksheet to calculate the value of manure. (Instructions for most lines are on page 2.)

Manure Source: Upper Lots
Field: Dad's 80, S-20 Ac
Date: Nov. 5, '12

Section	Line	Nitrogen: Ammonium N	Nitrogen: Organic N	Nitrogen: Total N	P2O5	K2O	Sulfur	Zinc
Nutrient Plan	1. Manure nutrient content from manure test report (lbs/ton, lbs/1,000 gal, or lbs/acre-inch).	2	16		18	14	5	0.3
	2. Nutrient availability factors. *See Tables I and II for nitrogen availability*.	0.5	0.4		1.0	1.0	1.0	1.0
	3. Available nutrients (lbs/ton, lbs/1,000 gal, or lbs/acre-inch). Multiply *line 1* x *line 2.*	1	6.4	7.4	18	14	5	0.3
	4. Nutrient recommendations for the next crop (lbs/acre/year).			90	40	0	0	2.5*
	5. Manure application rate. To meet crop nitrogen need, divide total nitrogen in *line 4* by *line 3* (round to whole units) (tons/ac, 1000 gal/ac, or acre-inches).			12				
Nutrients of Value	6. Total nutrients available (lbs/ac). Multiply each value in *line 3* x *line 5* (application rate).			89	216	168	60	4
	7. Nutrient need for four years (except N) (lbs/ac). *Multiply line number 4 x 4.*				160	0	0	5
	8. Additional nutrients of value (lbs/ac).			19[A]	56[B]	0[C]	0[D]	0[E]
	9. Total nutrients of value (lbs/ac).			108	216	0	0	4
Total and Net Value	10. Fertilizer nutrient costs ($/lb).			0.65	0.65	0.50	0.50	3.00
	11. Manure nutrient values ($/ac). Multiply *line 9* x *line 10.*			70.20	140.40	0	0	12
	12. Estimated value of yield increase ($/ac).	$47.00						
	13. **Total value of applied manure** ($/ac). Sum all values in *line 11* and *line 12.*	$269.60/acre						
	14. **Manure value per unit** ($/ton, $/1,000 gal, $/acre-inch, $/load). Divide *line 13* by *line 5*, or by loads per acre.	$22.47/ton						
	15. **Manure costs:** hauling, spreading, incorpora- tion ($/ac).	$8.00/acre**						
	16. **Net value of manure** ($/ac). *Line 13* minus *line 15.*	$261.60/acre						
Need	17. Nutrients still needed for *this* year's crop (lbs/ac). *Line 4* minus *line 6.*			0	0	0	0	0

*Zinc is half the corn recommendation due to averaging 5 lbs/acre with zero for soybean. Use 5 lbs/acre for *line 4* when calculating zinc in *line 17*.

**Note that this is an estimated cost using a custom manure applicator with larger equipment. Costs per acre may be different with smaller equipment.

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References

1. This worksheet is based on a publication from the University of Missouri, *Calculating the Value of Manure as a Fertilizer Source*, G9330, https://extension.missouri.edu/publications/g9330.

2. *Nutrient Management for Agronomic Crops in Nebraska*, University of Nebraska–Lincoln Extension EC155, https://extensionpubs.unl.edu/publication/9000016363764/nutrient-management-for-agronomic-crops-in-nebraska/.

3. Fertilizer Suggestions for Corn, EC117 (revised December 2014), https://extensionpubs.unl.edu/publication/9000016366926/fertilizer-suggestions-for-corn/.

4. Fertilizer Suggestions for Soybeans, G859 (revised April 2019), https://extensionpubs.unl.edu/publication/9000016361216/fertilizer-recommendations-for-soybean/.

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